Universe International Journal of Interdisciplinary Research
(Peer Reviewed Refereed Journal)

© UIJIR | ISSN (O) – 2582-6417
NOVEMBER 2022 | Vol. 3 Issue 6
www.uijir.com

REVIEW ARTICLE ON ABC OF BLOOD GROUPS

Author's name: [1]Mohammed Sheikh Ismail, [2]Dr. Abdul Latif

Affiliation: [1]Research Scholar Nursing J.J.T.U. Rajasthan, India,

[2]Principal KGN College of Nursing, Sikar, PhD Nursing. Rajasthan, India

DOI No. – **08.2020-25662434**

Abstract

International Society of Blood Transfusion has recently recognized 33 blood group systems. Apart from ABO and Rhesus system, many other types of antigens have been noticed on the red cell membranes. Blood grouping and cross-matching is one of the few important tests that the anesthesiologist orders during perioperative period. Hence, a proper understanding of the blood group system, their clinical significance, typing and cross-matching tests, and current perspective are of paramount importance to prevent transfusion-related complications. Nonetheless, the knowledge on blood group system is necessary to approach blood group-linked diseases which are still at the stage of research. This review addresses all these aspects of the blood groups system.

Keywords: *Blood groups and ABO typing*

INTRODUCTION

The term "blood group" refers to the entire blood group system comprising red blood cell (RBC) antigens whose specificity is controlled by a series of genes which can be allelic or linked very closely on the same chromosome. "Blood type" refers to a specific pattern of reaction to testing antisera within a given system. Over a period of time, our understanding on blood groups has evolved to encompass not only transfusion-related problems but also specific disease association with RBC surface antigens. Karl Landsteiner has been credited for the discovery of ABO blood group system in 1900 His extensive research on serology based on simple but strong scientific reasoning led to identification of major blood groups such as O, A, and B types, compatibility testing, and subsequent transfusion practices. He was awarded Noble Prize in 1930 for this discovery. His obituary lists an immense contribution of more than 346 publications. Later, Jan Jansky described classification of human blood groups of four types.

TYPES OF BLOOD GROUP SYSTEMS

THE ABO SYSTEM

ABO SYSTEM

Among the 33 systems, ABO remains the most important in transfusion and transplantation since any person above the age of 6 months possess clinically significant anti-A and/or anti-B antibodies in their serum. Blood group A contains antibody against blood group B in serum and vice-versa, while blood group O contains no A/B antigen but both their antibodies in serum.

MNS SYSTEMS

After the discovery of the ABO Blood group system no new blood group systems were found for 25 years. MNS antigen system, first described by Landsteiner and Levine in 1927 is based on two genes: Glycophorin A and Glycophorin B. The blood group is under control of an autosomal locus on chromosome 4 and also under control of a pair of co-dominant alleles LM and LN. Anti-M and anti-N antibodies are usually IgM types and rarely, associated with transfusion reactions.

THE RH SYSTEM

Rhesus-system is the second most important blood group system after ABO.[4] Currently, the Rh-system consists of 50 defined blood group antigens out of which only five are important. RBC surface of an individual may or may not have a Rh factor or immunogenic D-antigen. Accordingly, the status is indicated as either Rh-positive (D-antigen present) or Rh-negative (D-antigen absent). In contrast to the ABO system, anti-Rh antibodies are, normally, not present in the blood of individuals with D-negative RBCs, unless the circulatory system of these individuals has been exposed to D-positive RBCs. These immune antibodies are immunoglobulin G (IgG) in nature and hence, can cross the placenta. Prophylaxis is given against Rh immunization using anti-D Ig for pregnant Rh-negative mothers who have given birth to Rh-positive child.

BOMBAY BLOOD GROUP

Individuals belonging to Bombay blood group (oh) [9] are homozygous for the absence of H gene i.e., they are of the genotype 'hh', so that they are unable to bring about the initial part of conversion of the precursor blood group substance. This means that even if 'A' and 'B' genes are present they have no substrate for their normal function of producing 'A' and 'B' blood group substances. The ABO genes cannot therefore be expressed and such individuals appear to belong to 'O' but their true state can be detected because of the presence in their serum of anti-H .Thus the 'Bombay phenotype', lack 'A', 'B' and 'H' antigens on their erythrocytes and in secretions. Nevertheless they appear to have normal 'A' and 'B' genes that can be expressed in the next generation if their children acquire an 'H' gene from the other parent. It follows that there is no 'O' antigen; group 'O' erythrocytes and the saliva of group 'O' secretors contain 'H' antigen, but the designation group 'O' erythrocytes has been retained for historical reasons.

LUTHERAN SYSTEM

Lutheran system comprised of four pairs of allelic antigens representing single amino acid substitution in the Lutheran glycoprotein at chromosome 19. Antibodies against this blood group are rare and generally not considered clinically significant.

Kell system

These erythrocyte antigens are the third most potent immunogenic antigen after ABO and Rh system, and are defined by an immune antibody, anti-K. It was first noticed in the serum of Mrs. Kellacher. She reacted to the erythrocytes of her newborn infant resulting in hemolytic reactions. Since then 25 Kell antigens have been discovered. Anti-K antibody causes severe hemolytic disease of the fetus and newborn (HDFN) and haemolytic transfusion reactions (HTR).

LEWIS BLOOD GROUP SYSTEM

The Work of Mourant (1946) and subsequent work of Grubb (1951) and Ceppellini (1955) [13] showed that Lewis antigen is also found on red blood cells and is related to ABO system and secretion of ABH antigens. There are two types of Lewis antigen and designated as Lea and Leb respectively, and give rise to three red blood cell phenotypes which are designated as Le(a - b+), Le(a + b -), Le(a - b -). The synthesis of Le antigen is regulated by the independent gene Le. The Lewis antigen appears on the same glycoproteins as the ABH determinants. These antigens are synthesized from the same precursor substance as ABH antigen.

DUFFY SYSTEM

Duffy-antigen was first isolated in a patient called Duffy who had hemophilia. It is also known as Fy glycoprotein and is present in the surface of RBCs. It is a nonspecific receptor for several chemokines

and acts as a receptor for human malaria parasite, *Plamodium vivax*. Antigens Fya and Fyb on the Duffy glycoprotein can result in four possible phenotypes, namely Fy(a+b−), Fy(a+b+), Fy(a−b+), and Fy(a−b−). The antibodies are IgG subtypes and can cause HTR.

KIDD SYSTEM

Kidd antigen (known as Jk antigen) is a glycoprotein, present on the membrane of RBCs and acts as a urea transporter in RBCs and renal endothelial cells. Kidd antibodies are rare but can cause severe transfusion reactions. These antigens are defined by reactions to an antibody designated as anti-Jk^a, discovered in the serum of Mrs. Kidd who delivered a baby with HDFN. Jk^a was the first antigen to be discovered by Kidd blood group system, subsequently, two other antigens Jk^b and Jk3 were found.

OTHER BLOOD GROUP SYSTEMS

The structure and functions of the membrane proteins and glycoprotein carrying blood group antigens have been reviewed by carton and Daniels .The H antigen content of red cells depends on the ABO group and when assessed by agglutination reactions with anti-H, the strength of reaction tends to be graded O > A2 > A2B > B > A1 > A1B. Other subgroups are occasionally found. The A, B, and H antigens are detectable early in fetal life but are not fully developed on the red cells at birth. The number of antigen sites reaches adult level at around 1 year of age and remains constant until old age, when a slight reduction may occur. The ability to secrete A, B and H substances in water soluble form is controlled by FUT2 (dominant allele Se).

The main four groups of ABO system are inherited as Mendelian characters by three allelic genes, A, B, and O

Table: ABO Blood group system in different individuals

Blood group phenotype	Antigen on RBC	Antibodies in serum
AB	A AND B	- (nil)
A	A	Anti-B (β)
B	B	Anti-A (α)
O	NONE	Anti-AB(αβ)

IMPORTANCE OF BLOOD GROUPS

Only ABO and Rh Blood group systems are having major clinical importance from the point of view of blood transfusion and others are of less importance because the corresponding antibodies are either absent normally or occur rarely, and when present, they usually react at low temperature (cold agglutinins) (Dacie and Lewis et al.,) and do not precipitate transfusion Blood groups study forms a comparatively small field of study but they have important Place in genetics, immunology, anthropology, Clinical medicine and in forensic medicine. , blood groups can be applied to various problems of identity, parentage and paternity. In addition the ABO and Lewis antigens of secretors can be used in the examination of dried stains of saliva, seminal stains and plasma. The blood group systems in addition to blood replacement therapy are now being applied to study genetic inheritance, serological and immunological problems, anthropological studies and legal medicine.

REFERENCES

1. Owen R. Karl Landsteiner and the first human marker locus Genetics. 2000;155:995–8
2. Lögdberg L, Reid ME, Lamont RE, Zelinski T. Human blood group genes 2004: Chromosomal locations and cloning strategies Transfus Med Rev. 2005;19:45–57

3. Lögdberg L, Reid ME, Zelinski T. Human blood group genes 2010: Chromosomal locations and cloning strategies revisited Transfus Med Rev. 2011;25:36–46
4. Westhoff CM. The Rh blood group system in review: A new face for the next decade Transfusion. 2004; 44:1663–73
5. Agarwal N, Thapliyal RM, Chatterjee K. Blood group phenotype frequencies in blood donors from a tertiary care hospital in north India Blood Res. 2013;48:51–4
6. Anstee DJ. The functional importance of blood group-active molecules in human red blood cells Vox Sang. 2011; 100:140–9
7. Daniels G, Reid ME. Blood groups: The past 50 years Transfusion. 2010; 50:281–9
8. Denomme GA. The structure and function of the molecules that carry human red blood cell and platelet antigens Transfus Med Rev. 2004;18:203–31
9. Luo H, Chaudhuri A, Zbrzezna V, He Y, Pogo AO. Deletion of the murine Duffy gene (Dfy) reveals that the Duffy receptor is functionally redundant Mol Cell Biol. 2000;20:3097–101
10. Rao N, Ferguson DJ, Lee SF, Telen MJ. Identification of human erythrocyte blood group antigens on the C3b/C4b receptor J Immunol. 1991;146:3502–7
11. Telen MJ, Hall SE, Green AM, Moulds JJ, Rosse WF. Identification of human erythrocyte blood group antigens on decay-accelerating factor (DAF) and an erythrocyte phenotype negative for DAF J Exp Med. 1988;167:1993–8
12. Zhang H, Mooney CJ, Reilly MP. ABO Blood Groups and Cardiovascular Diseases Int J Vasc Med 2012. 2012:641917
13. Wiggins KL, Smith NL, Glazer NL, Rosendaal FR, Heckbert SR, Psaty BM, et al ABO genotype and risk of thrombotic events and hemorrhagic stroke J Thromb Haemost. 2009;7:263–9
14. Tufano A, Coppola A, Nardo A, Bonfanti C, Crestani S, Cerbone AM, et al Non-O blood group as a risk factor for cerebral vein thrombosis Thromb Haemost. 2013;110:197–9